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PHYLLOPHORUS (*URODEMELLA*) *ARENICOLA*, A NEW SUBLITTORAL SEA CUCUMBER FROM THE SOUTHEASTERN UNITED STATES (ECHINODERMATA: HOLOTHUROIDEA)

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Abstract.—*Phyllophorus* (*Urodemella*) *arenicola* new species is described. It is an offshore species living in depths of 6–158 meters off Georgia and eastern Florida, and it has been confused with the more widely distributed *P.* (*U.*) *occidentalis* (Ludwig 1875), known from depths of only 2 meters or less.

In the course of a monographic revision of the western Atlantic holothurians, one of us (JEM) noted that the offshore species described below is new, and that Miller & Pawson (1984) had confused this distinctive species with *P.* (*U.*) *occidentalis* (Ludwig 1875), which is known from Florida, Puerto Rico, Antigua, Barbados, Grenada, Aruba, Trinidad, Surinam and Brazil, in a depth of 0–2 m (Deichmann 1930, 1954). The specimen illustrated in fig. 27 on p. 36 of Miller & Pawson (1984) is *P.* (*U.*) *arenicola,* but the body wall ossicles (tables) illustrated in fig. 28 on p. 37 are those of *P.* (*U.*) *occidentalis.*

We are grateful to Paula Mikkelsen (Harbor Branch Oceanographic Institution), Gordon Hendler (Los Angeles County Museum), Hugh Reichardt and Woody Lee (Smithsonian Marine Station) for collaborating in SCUBA diving expeditions, and to Julie Piraino (Smithsonian Marine Station) for taking the Scanning Electron Micrographs.

Type specimens and other material are deposited in the National Museum of Natural History, Smithsonian Institution (USNM) or the Harbor Branch Oceanographic Museum, Fort Pierce, Florida (HBOM). This is Contribution No. 298 from the Smithsonian Marine Station at Link Port, and No. 900 from the Harbor Branch Oceanographic Institution.

Order Dendrochirotida Grube, 1840
Family Phyllophoridae Östergren, 1907 (emend. Pawson & Fell, 1965)

Diagnosis.—Body not enclosed by a test of conspicuous ossicles; ossicles in body wall small, inconspicuous. Calcareous ring complex, with paired or unpaired posterior processes; processes composed of a mosaic of minute pieces. (From Pawson & Fell 1965.)

Phyllophorus Grube, 1840
Phyllophorus (*Urodemella*) Deichmann, 1944

Diagnosis.—Dendrochirote holothurians with 20 tentacles in two rings (15 + 5). Calcareous ring with short projections, composed of a few pieces. Feet in large animals regularly scattered over the body. Calcareous bodies reduced towers or thorny plates derived from towers. (From Heding & Panning 1954.)

Type species.—*Phyllophorus holothurioides* Ludwig, 1875.

Remarks: In their revision of the classification of the Order Dendrochirotida, Pawson & Fell (1965) attempted to delineate families on the basis of a combination of characters of the ossicles in the bodywall and the calcareous ring. The Family Phyllophoridae in the broad sense was intended to contain only dendrochirotes in which the posterior projections of the calcareous rings

are composed of numerous small pieces. Not all members of the subgenus *Urodemella* conform to this diagnosis. The western Atlantic species *P.* (*U.*) *occidentalis* (Ludwig) has a calcareous ring in which the posterior projections on the radial pieces may appear to be solid, or they may be "composed of small calcareous plates" (Ludwig 1875:119). The interradial pieces may carry "posterior accessory plates" (Deichmann 1930:149) or these plates may not be separated from the interradial pieces in certain parts of the ring, according to Deichmann. In the new species described below, the ring seems to lack accessory plates. Despite the apparent variation in the structure of the ring, the ossicles in this group are distinctive, and diagnostic.

In their diagnosis of the subgenus *Phyllophorus* (*Urodemella*), Heding & Panning (1954) noted (p. 161) that the tentacles are arranged in two rings, the outer ring with 15 tentacles and the inner ring with 5. However, in their description of *P.* (*U.*) *occidentalis,* they noted a 10 + 10 tentacle arrangement; a similar plan exists in the new species described here. Details of tentacle arrangement are apparently not reliable characters at the subgenus level in this group.

Phyllophorus (*Urodemella*) *arenicola,* new species
Figs. 1–4

Phyllophorus (*Urodemella*) *occidentalis.*—Miller & Pawson, 1984, p. 36, figs. 27, 28. (Not *Phyllophorus* (*Urodemella*) *occidentalis* Ludwig, 1875.)

Diagnosis.—Tentacles 20 in 2 rings, 5 large pairs in outer ring alternating with 5 small pairs in inner ring. Body wall ossicles square tables averaging 66 μm in length, commonly with 5 or 8 perforations, of which 2 are larger than others; spire reduced to form 4 vertical projections. Introvert and tentacles with tables and rosettes.

Type material.—Holotype (USNM E42486) and six paratypes (USNM E42487, 6 specimens) Station RF-19-88, 24 May 1988, Capron Shoal, off Hutchinson Island, St. Lucie County, Florida, 6–12 m, collected J. E. Miller and P. Mikkelsen. Six paratypes (HBOM 071:00580), Capron Shoal, off Hutchinson Island, St. Lucie County, Florida,25 Sep 1991, 27°26.859′N, 80°11.670′W, 13.8 m, collected P. Mikkelsen and W. Lee.

Additional material (abbreviated data).—USNM E19577, off Georgia, 30°57′N, 79°58′W, 158 m; USNM E19706, off Florida, 29°28′N, 80°57′W, 20 m; USNM E19709, off Florida, 29°28′N, 80°57′W, 20 m; USNM E19710, off Florida 29°28′N, 80°57′W, 20 m; HBOM 071:00353, off Florida 28°00′N, 80°12′W, 27.4 m; HBOM 071:00354, off Florida, 30°20′N, 80°14′W to 30°19′N, 80°14′W, 64–65.9 m; HBOM 071:00368, off Florida, 27°40.1′N, 80°13.5′W, 18.3 m.

Description.—Total length of live individuals may exceed 30 cm; contracted animals usually less than 10 cm long. Body more or less cylindrical, slightly U-shaped in life (Fig. 1), tapering gently towards anterior and posterior ends. Body wall thin, soft to touch, becoming firmer and thicker in contracted specimens. Color in life uniform to variegated light reddish brown. Tube feet small, soft, scattered over most of body, with tendency to form double rows in radii. At introvert feet tend to be restricted to radii, in double rows; at extreme posterior end of body, feet also restricted to radii. Tentacles 20, outer ring of 5 large pairs alternating with inner ring of five small pairs. In partially contracted paratype 115 mm long, 5 pairs of large tentacles are 7–10 mm long, 5 pairs of small tentacles are 1–2 mm long.

In 120-mm long paratype (USNM E42487) 2 Polian vesicles arise from ventral side of water-vascular ring. Intestine long, describing large loop. Respiratory trees very extensive, white-transparent, occupying most of body cavity. Gonad a large tuft of sparsely branched tubules approximately 1 cm long, arising from elongate (20 mm long) rachis near mid-dorsal body wall.

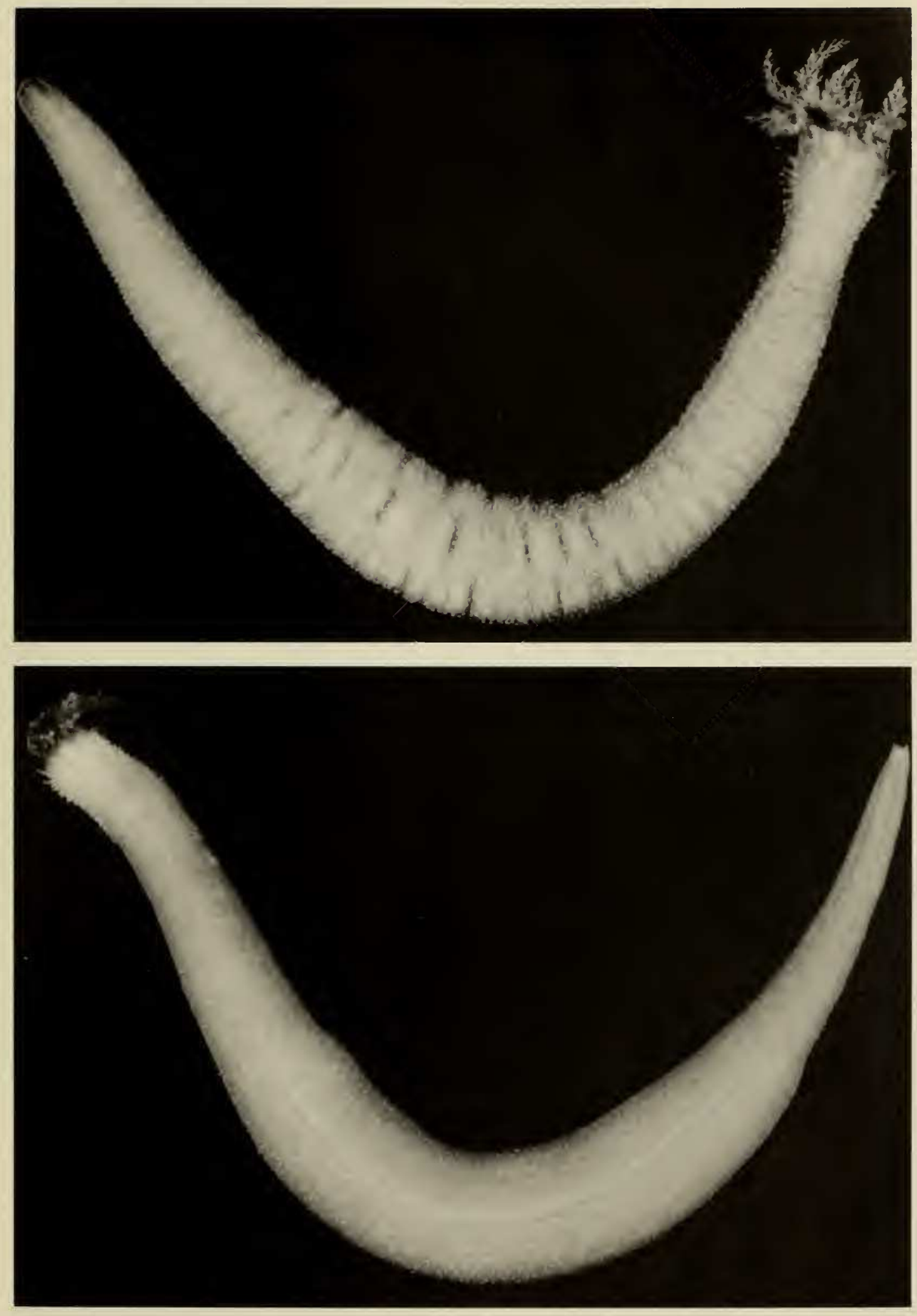

Fig. 1. *Phyllophorus* (*Urodemella*) *arenicola,* new species. Lateral views of 2 live animals. A, Upper, total length 200 mm; B, Lower, total length 220 mm.

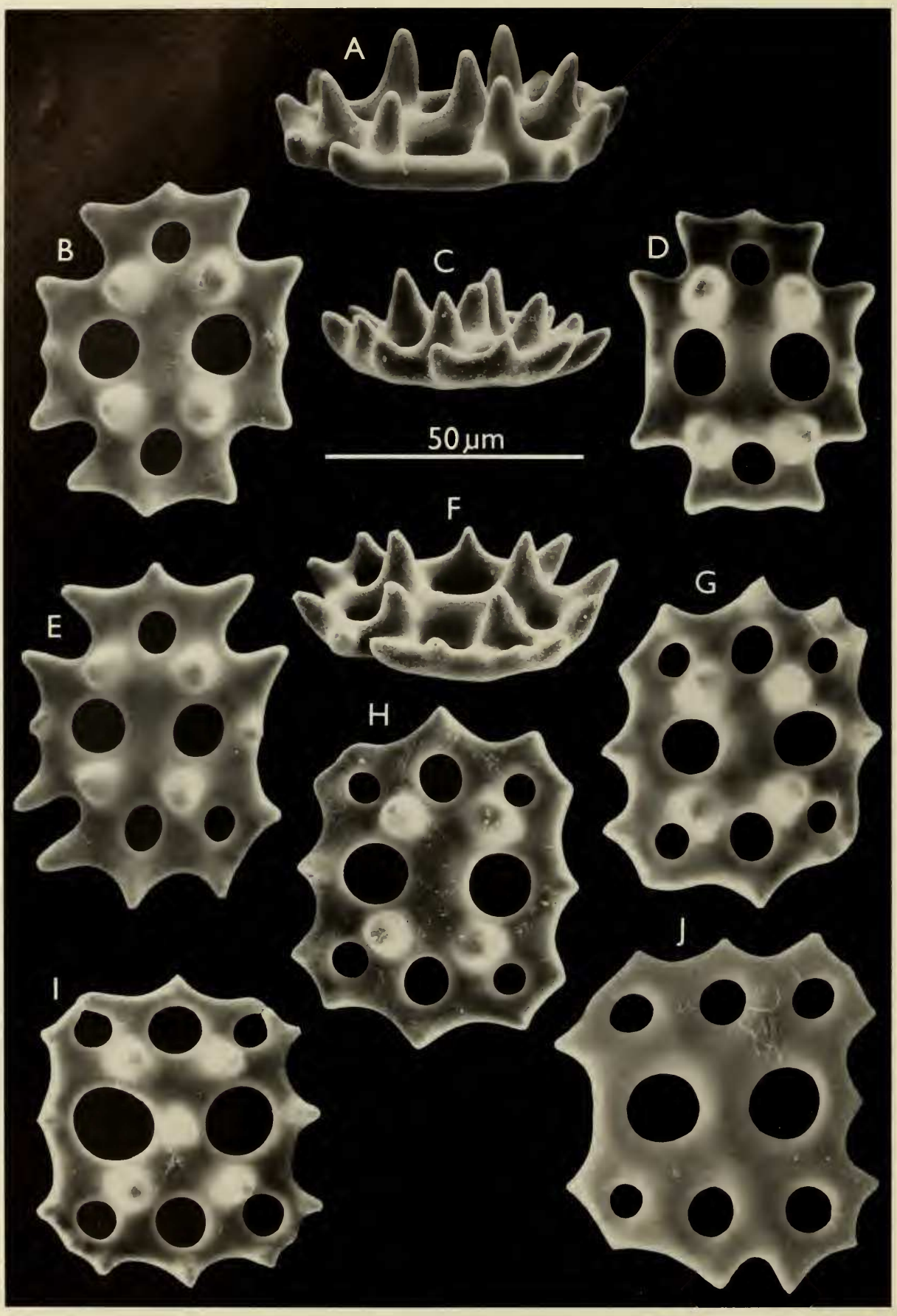

Fig. 2. *Phyllophorus* (*Urodemella*) *arenicola*, new species. Scanning electron micrographs of dermal ossicles; tables from mid-body. A, F—oblique view; B, D, E, G, H, I—outer view; C—lateral view; J—inner view.

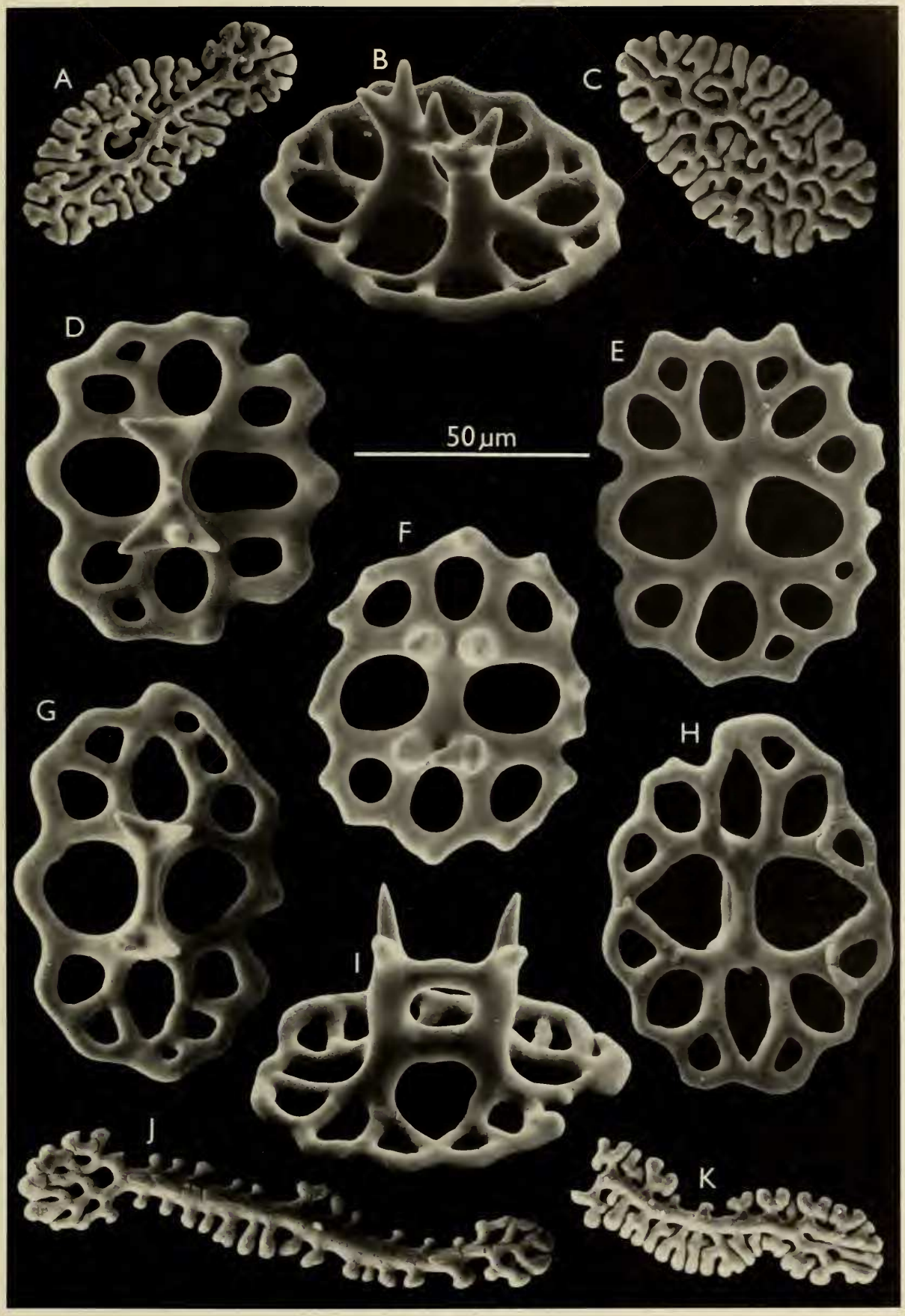

Fig. 3. *Phyllophorus* (*Urodemella*) *arenicola,* new species. Scanning electron micrographs of dermal ossicles; tables and rosettes from introvert (A–F), and from tentacles (G–K). A, C, rosettes from introvert; B, D, E, F—tables from introvert in oblique, outer, inner, and outer views respectively. G, H, I—tables from tentacles in outer, inner, and oblique views respectively. J, K—rosettes from tentacles.

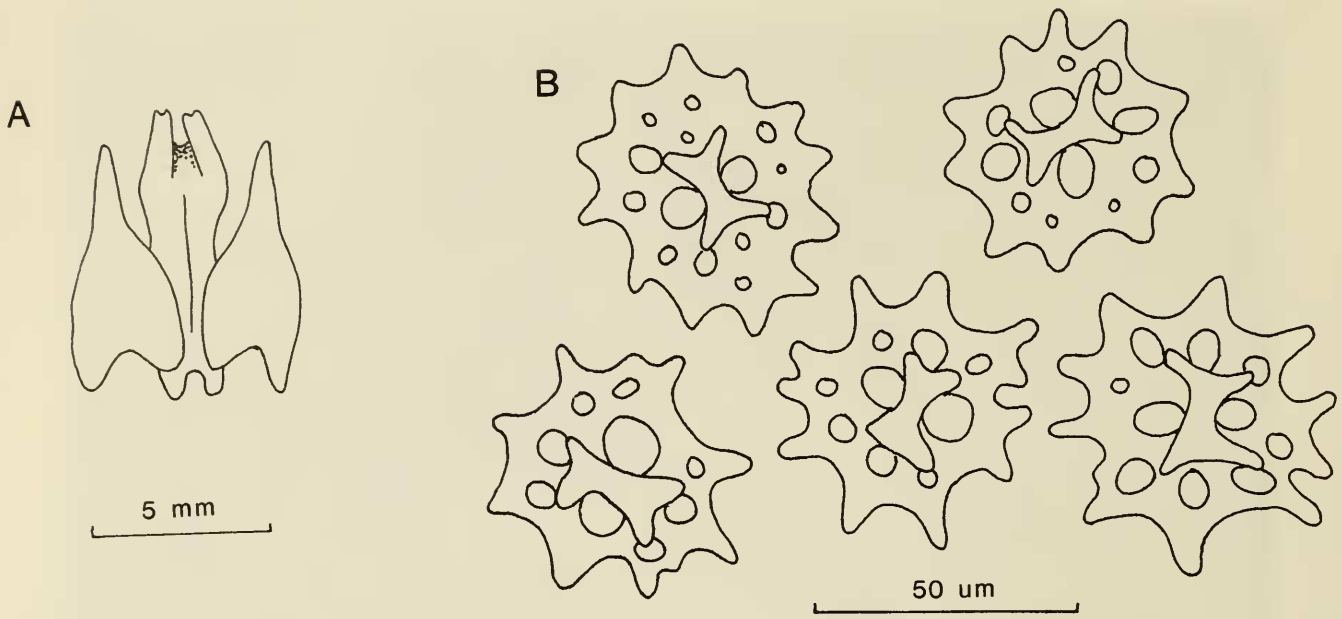

Fig. 4. *Phyllophorus* (*Urodemella*) *arenicola*, new species. A, radial and interradial pieces of calcareous ring from specimen of 90 mm total length. *P.* (*U.*) *occidentalis* (Ludwig). B, tables from body wall.

Radial pieces of calcareous ring (Fig. 4A) approximately rectangular, with deep frontal notch and 2 short posterior projections. Distinct ridge lies on long axis of outer surfaces of each radial piece. Interradials approximately oval, with sharp anterior projection and broad, shallow posterior notch. No evidence of mosaic construction of posterior projections of radial or interradial pieces.

Ossicles in body wall exclusively squarish tables (Fig. 2) with scalloped margins and 4 or more perforations; commonly 8 perforations present. In most cases 2 perforations slightly larger than others. Spire reduced to form 4 discrete bluntly pointed vertical projections. Marginal projections extend laterally and also vertically. In oblique or lateral view projections and spire pillars similar, conspicuous. Inner surface of tables (Fig. 2J) smooth. The tables are 61–74 μm long, average length 66 μm (*SD* 2.85). In introvert ossicles in form of tables (Fig. 3B, D–F) and rosettes (Fig. 3A, C). Tables slightly larger than body wall tables, usually with 8 or more perforations, of which 2 tend to be largest. Marginal projections less conspicuous than in body wall tables. Spire may be slightly better developed (Fig. 3B), or similar to spires in body wall (Fig. 3F). Inner surface of these tables (Fig. 3E) smooth. Rosettes in introvert (Fig. 3A, C) average 67 μm in length, flattened, complex, with numerous branches. Tentacles contain tables (Fig. 3G–I) and rosettes (Fig. 3J–K). Tentacle tables similar in general features to those from introvert, except that spire is usually better developed, with 2 cross-pieces (Fig. 3I). Tentacle rosettes simpler, more elongate (exceeding 120 μm in length) than introvert rosettes.

Biology.—When collected by dredging or trawling, this animal frequently is in two pieces, because the anterior end, comprising the introvert, tentacles, calcareous ring and associated structures, is commonly autotomized. At the Capron Shoal locality (the type locality), individuals live buried in an unconsolidated sand and shell hash bottom, with only their feeding tentacles extended into the water. In areas where there are ripple marks, individuals were found in the ridges, and were uncovered by pushing the tops of the ridges to one side with the hand (W. Lee & P. Mikkelsen, pers. comm.). This species can rapidly retract its tentacles and introvert to a depth of approximately 10 cm below the substrate surface.

Paratypes (HBOM 071:00580) collected in September 1991 were maintained alive in clean seawater in the laboratory for three days, and their feces collected and analysed. Feces consisted of unidentifiable flocculent material, and it seems likely that this species is a true suspension feeder, capturing organic material with its richly branched tentacles. Whether in total darkness or in lighted conditions, live animals almost never extended their tentacles, even when seawater with suspended organic particles was introduced into the holding tank.

Etymology.—The species name is a noun in apposition, derived from Latin *arena*—sand, in reference to the preferred habitat of this species.

Distribution.—Recorded from off Georgia and eastern Florida in depths of 6–158 meters. *P.* (*U.*) *arenicola* appears to be a strictly offshore species.

Remarks.—This species shares some characters with *P.* (*U.*) *occidentalis* (Ludwig). The general appearance of the body and arrangement of the tentacles is similar in both species, although they differ in color, *P.* (*U.*) *occidentalis* being light to dark brown to yellow, while *P.* (*U.*) *arenicola* always seems to be light reddish brown. The body wall tables of *P.* (*U.*) *occidentalis* (Fig. 4B) are smaller, with a size range of 49–63 μm and a mean length of 55 μm (*SD* 3.38), and the four pillars of the spire are joined together near the base. The radial pieces of the calcareous ring in *P.* (*U.*) *occidentalis* have a flat or concave outer surface—there is no trace of a longitudinal ridge.

The other species in this subgenus are known from the Indo-Pacific, and differ in numerous details from both *occidentalis* and *arenicola* (Heding & Panning 1954).

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